MARIE CURIE CONFERENCE

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RAILWAY NOISE BARRIERS: MEASUREMENTS AND SIMULATIONS

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INTRODUCTION

Trains passages generate a very annoying noise to the inhabitants of their environs. To reduce this annoyance, noise barriers are installed near several railway lines. Nowadays, acoustic simulation programs are used in order to optimize the design of the acoustic barriers. These programs use mathematical models to characterize the noise source and to predict the sound propagation.

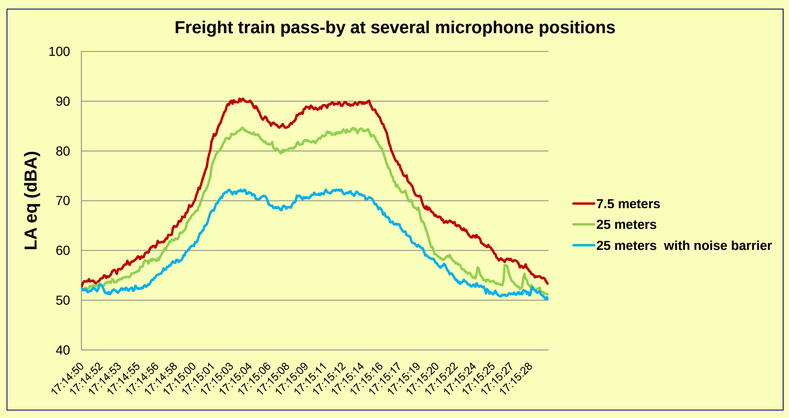
MATTER

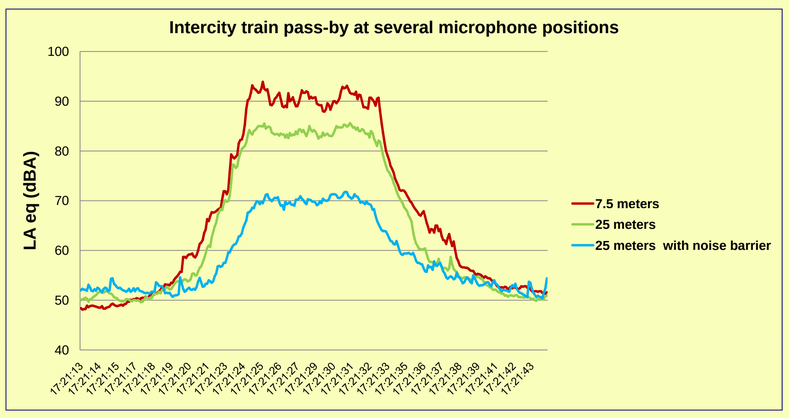
Several models of noise source characterization exist and the countries that do not have their own model, adopt foreign models. In addition, every simulation program implements the propagation models in diverse ways, which implies a difference in the final result.
This is a part of an ongoing research project and some of its results were presented in DAGA, AIA and ICA Congress.

MEASUREMENTS AND PROCESS

To make a qualitative and quantitative comparison, experimental measures have been made, characterizing the noise sources. The measurements were carried out in three scenarios:
- Free field conditions that were verified before measuring (scenario 1)
- Noise barriers in free field (scenario 2)
- Noise barriers in urban environs (scenario 3)

The measurements were done following ISO 3095 “Railway applications – Acoustics - Measurement of noise emitted by railbound vehicles”. The instruments used were class/type 1 and all the environmental guidelines were followed in order to achieve valid measurements. More than 150 train pass-bys were measured and several Italian trains were characterized, among other, in terms of length and speed using a tachymeter.

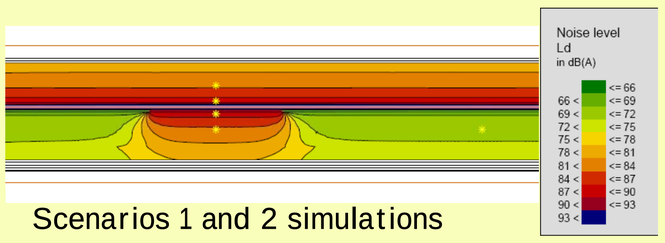




Pictures showing several scenarios

SIMULATIONS

Several simulations on different programs have been done using RMR 2002 calculation model.
A first exhaustive simulation using SoundPLAN has been carried out.
Future simulations will be done using LimA and Cadna software.

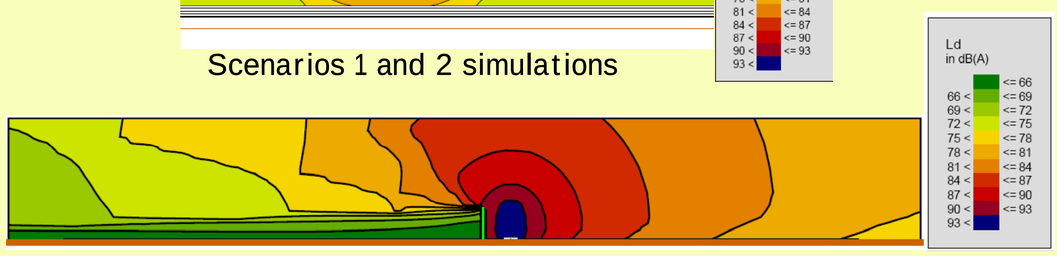


Scenarios 1 and 2 simulations

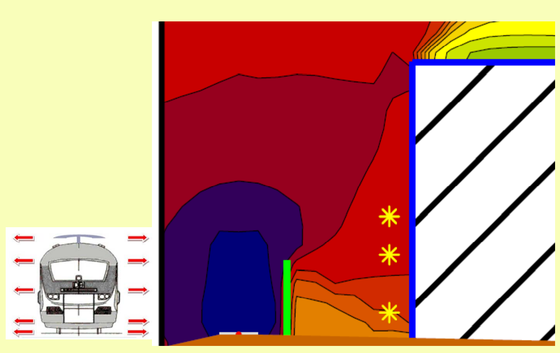
RESULTS

Measurements and simulation results comparing free field and noise barrier in free field environs at large distances are quite close. However, in urban environs we find higher differences.

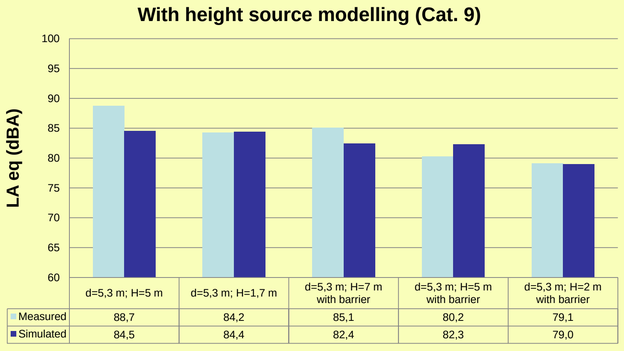
The greater deviation between the measurements and the simulation is in the microphones located behind the acoustic barrier. This is due to the simulated vertical diffraction and the source height modelization.



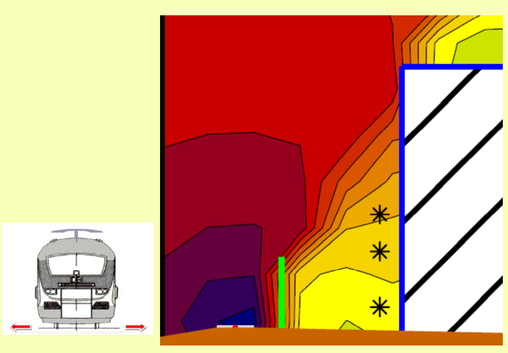
Cross section (scenario2)



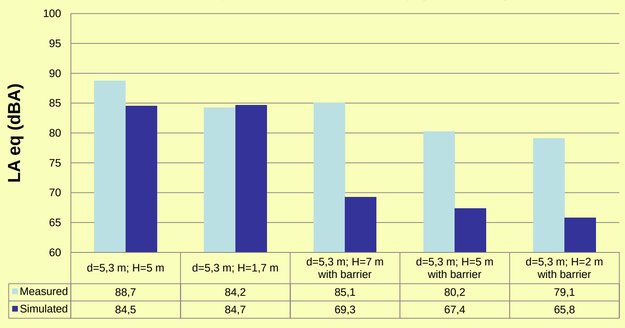
With height source modelling (Cat. 9)



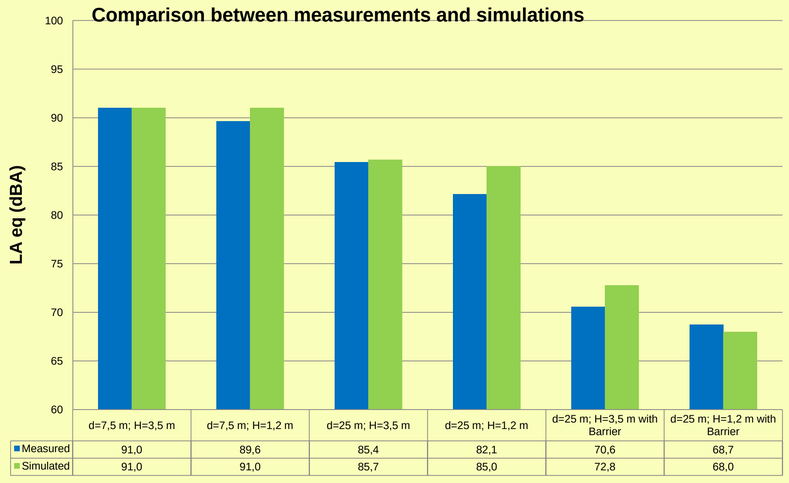
	d=5,3 m; H=5 m	d=5,3 m; H=1,7 m	d=5,3 m; H=7 m with barrier	d=5,3 m; H=5 m with barrier	d=5,3 m; H=2 m with barrier
Measured	88,7	84,2	85,1	80,2	79,1
Simulated	84,5	84,4	82,4	82,3	79,0



Without height source modelling (No Cat.9)



	d=5,3 m; H=5 m	d=5,3 m; H=1,7 m	d=5,3 m; H=7 m with barrier	d=5,3 m; H=5 m with barrier	d=5,3 m; H=2 m with barrier
Measured	88,7	84,2	85,1	80,2	79,1
Simulated	84,5	84,7	69,3	67,4	65,8



	d=7,5 m; H=3,5 m	d=7,5 m; H=1,2 m	d=25 m; H=3,5 m	d=25 m; H=1,2 m	d=25 m; H=3,5 m with Barrier	d=25 m; H=1,2 m with Barrier
Measured	91,0	89,6	85,4	82,1	70,6	68,7
Simulated	91,0	91,0	85,7	85,0	72,8	68,0

Values obtained adjusting the lineal source power to the reference microphone (at 7.5 meters distance and 3.5 meters height)

Figures and data on the left show the simulation results taking into account the height source for high-speed trains (Eurostar). On the right figures the height source is set at 0 meters, so the vertical diffraction is completely different than in the other case.

CONCLUSIONS

RMR 2002 model is the only one (implemented on software tested) that takes into account the source heights although it does only for high-speed trains (Category 9), setting its sources at 0, 0.5, 2, 4 and 5 meters. When calculating Noise Levels at different height receptors it is absolutely necessary to take into account the source height characterization depending on calculation model. Simulation results considering the sound source heights are more similar to measurements results.